SMALLHOLDER MAIZE FARMER'S WILLINGNESS TO JOIN INDEX INSURANCE IN VHEMBE DISTRICT: LIMPOPO PROVINCE

Miss Mukwevho Hulisani
North West University
Mahikeng, South Africa
E-mail: HMukwevho@munichre.com

Prof Simon Letsoalo
North West University
Mahikeng Campus, South Africa
E-mail: Simon.letsoalo@nwu.ac.za

Dr Josepho Nembo Lekunze
North West University
Mahikeng, South Africa
E-mail: Joseph.lekunze@nwu.ac.za

Mr Usapfa Luvhengo
North West University
Mahikeng, South Africa
E-mail: 27375196@nwu.ac.za

ABSTRACT
Only a negligible proportion of smallholder farmers in South Africa have crop insurance to mitigate production risks. This article analyses the demand for index-based crop insurance by smallholder farmers in the Vhembe district of Limpopo Province in South Africa based on their willingness to join a proposed insurance product. The total population of smallholder farmers was categorised according to four local municipalities that make up the Vhembe district. Questionnaires were used to collect once off data from smallholder farmers. The contingent valuation method was used as a method of choice to further analyse the willingness to buy a crop insurance product. Analysis revealed that 86% of the farmers were willing to buy the index-based crop insurance. Further analysis using Probit regression model found that age, farm size, and risk management strategies were factors influencing smallholder farmers` willingness to buy crop insurance product. This study has shown that smallholder crop farmers` willingness to buy crop insurance products as a risk mitigation strategy is low in the Vhembe district of Limpopo. The study recommends awareness and education with regard to crop insurance purchase for smallholder farmers. This can be done as one of governments' intervention towards agriculture as a form of subsidy to resource poor farmers.

Keywords: Willingness to join, index-based crop insurance, Vhembe district, smallholder farmers.

1. INTRODUCTION

The use of insurance as a risk management tool is commonly used by other sectors or departments such as property and life but not so much in the agricultural sector specifically for smallholder farmers (Jepchumba, 2015). Demand for crop insurance by smallholder farmers is still very low in South Africa, with only a negligible number of smallholder farmers participating in agricultural insurance, especially in the rural areas (Partridge and Wagner, 2016). The crop insurance demand gap needs to be filled as insurance is an essential tool for risk management strategy (Fonta et al., 2018). Smallholder farmers generally have inadequate resources, meaning that if a loss occurs, resulting in a poor harvest, the smallholder farmers will suffer a loss of income and might not be able to continue farming.

Over the years, farmers have adapted several risk mitigation strategies such as crop diversification, crop rotation, and mixed farming, to name a few (Masara and Dube, 2017). Although the strategies that farmers apply are helpful, they are not enough to sustain their productivity, especially during unforeseen circumstances and uncalculated risk events. Thus, one of the solutions that large-scale commercial farmers use in most countries to manage

production risk is using crop insurance. (Daninga and Qiao, 2014). Crop insurance is a financial instrument used to transfer the crop production risk of loss from the farmers to the insurers for a specified premium (Iturrioz, 2009). In this way, they are stabilizing the farmer's financial status by offering protection against the impacts of crop failure and increasing the chances of farmers obtaining loans (Masara and Dube, 2017).

Worldwide, different types of crop insurance can be used as risk management tools such as multi-peril crop insurance, named peril crop insurance, and index-based crop insurance (Iturrioz, 2009). According to Ntukamazina, Onwonga, Sommer, Rubyogo, Mukankusi, Mburu and Kariuki (2017), index-based crop insurance is linked to indices, which can either be weather or average yield rather than focusing on the actual yield of an individual farmer. Index insurance solution solves most problems that limit the application of traditional insurance in rural areas. The main difference between traditional insurance and index insurance is that traditional insurance indemnifies the farmer's claims based on the actual loss on the farm, which requires loss assessment while index insurance cover shared risks amongst farmers with similar traits. Index insurance uses a proxy and sets up a threshold as a trigger for a pay-out; therefore, it does not require loss assessment (Burke, Janvry and Quintero, 2010). The key advantage of index-based insurance on smallholders is that costs of insurance are lower compared to traditional solutions, therefore affordable to smallholders (Barnett and Mahul, 2007). Advantages of index insurance on the insurer`s side are that there is no intense loss assessment required, a simpler distribution channel, and adverse selection is lower (Mapfumo, Groenendaal and Dugger, 2017). Index-based crop insurance avoids moral hazards such as perverse incentives where farmers would prefer their crops to fail in order to receive a pay-out.

Vhembe district is dominated by rural areas where smallholder crop farmers do not have access to affordable and straightforward insurance, which therefore makes them the target market for the emerging index insurance. Vhembe district is dominated by rural areas where smallholder crop farmers do not have access to affordable and straightforward insurance, which therefore makes them the target market for the emerging index insurance. Smallholder farmers are the most vulnerable as they are defined by (FAO, 2012), stating that smallholder farmers are those that own a small-based plot of land onto which they produce for subsistence purposes with a portion to sell while relying mostly on family labour and less expensive technology.

1.1. Problem statement

The exposure of maize production to various environmental risks necessitate the need for agricultural insurance to the farmers in order to allow for continuous production even after a loss (Kpodo, 2017). The use of insurance as a risk management tool is commonly used by other sectors or departments such as property and life but not so much in the agricultural sector specifically for smallholder farmers (Jepchumba, 2015). Demand for crop insurance by smallholder farmers is still very low in South Africa, with only a negligible number of smallholder farmers participating in agricultural insurance, especially in the rural areas (Partridge and Wagner, 2016). The crop insurance demand gap needs to be filled, as insurance is an essential tool for risk management strategy (Fonta et al., 2018). The insurance market for smallholder farmers is underdeveloped, and most smallholders have little understanding of insurance (Partridge and Wagner, 2016). There is still very little experimental focus in the literature about the demand side of insurance products, and therefore, more attention is required (Daninga and Qiao, 2014). The knowledge gap about factors influencing farmer's purchase of insurance still exists.

Objective: Thus, the objective of the study was to identify socio-economic factors that affect willingness to join and pay for index-based crop insurance by smallholder maize farmers in the Vhembe district.

Null Hypothesis: Socioeconomic factors do not affect willingness to join and pay for index-based crop insurance by smallholder maize farmers in the Vhembe district.

1.2. Ethical Considerations

Conduct during the research process was ethically correct in order to protect the North West University, the researcher, research participants and the environment. Participants were adequately and properly informed regarding the nature of the research project. The information collected from respondents was confidential. The respondents have was treated with respect and dignity. The respondents were informed that participation is voluntary.

2. RESEARCH METHODOLOGY

2.1. Study area

The study area was selected based on the knowledge that Maize production in Limpopo has recently suffered production losses, which are reflected by the decline in the (DAFF, 2018) maize production statistics. The outbreak of fall armyworm in Limpopo, specifically in the Vhembe district, has also resulted in maize production losses; therefore, this area requires attention. In addition, the assumption that the rural communities have little or no agricultural insurance as a tool for risk mitigation strategy contributed to the choice of the study area (Tlholoe, 2015). Smallholder farmers in developing countries such as South Africa face issues such as limited access to financial services and adequate risk management products (Makaudze, 2012).

2.2. Data collection

For the purpose of this paper, primary data was used. The stratification of farmers was applied, wherein the smallholder farmers were stratified according to the municipalities in the district as this was already a natural division and simple random sampling was used to obtain the number of smallholder farmers that are required from each municipality. Data were collected in all four municipalities of the Vhembe district, namely Makhado, Mutale, Musina, and Thulamela (following the old district structure due to data availability). Data was collected using a structured questionnaire and an in-depth interview with smallholder crop farmers in the study area.

2.3. Determination of sample size

Cochran's formula was used to calculate the ideal sample size of the smallholder farmers that was used in all the four municipalities. The sample size was determined to be 173 smallholder maize farmers using equation 1 below.

$$n_0 = \frac{z^2 pq}{e^2} \quad \text{.....(1)}$$

Where n_0 is the sample size, p is the estimated proportion of the population that comprises of the attributes that are in question, q is equal to $1- p$, e is the desired level of precision (margin of error) and z is the value found on the Z table according to the desired confidence interval.

2.4. Data analysis

From the WTJ questions, percentages and numbers of smallholder farmers interested in participating in index insurance and those that are not interested are presented. It is also essential to analyse and understand the factors affecting the willingness to join in the participation of the presented insurance product.

A Probit model was used to determine the factors influencing the decision of smallholder farmers to join in the participation of the index insurance product. Probit models are discrete choice models that are derived from utility theory (Jeyakrishnam and Umashnkar, 2015). The utility function assumes that farmers will always maximize their utility (Balana, Catacutan and Makela, 2013).

This model was chosen based on the ability to take two dependent variables, in this case being the willingness and unwillingness of smallholder farmers to join in the participation of the index-based crop insurance product. Trang (2013) used the same model to analyse the willingness to join the Area Yield Index for Rice farmers in Vietnam with the following general probit model.

The general Probit model is stated as equation (2) below:

$$Y_a = \beta_o + \sum_{a-1}^{n} \beta_n x_a + \mu_a \text{.....(2)}$$

Y_a = the dependent variable, in this case, is the willingness or unwillingness to join in the participation of index insurance product.

Y_a = 1, if the farmers respond that they are willing to join in the participation of the index insurance product.

Y_a = 0, if the farmers respond that they are not willing to join in the participation of index insurance product.

β_o = intercept

β_n = the coefficients that explain the probability of farmers willingness

μ_a = the error term

x_a= The independent variable that is selected based on a literature review.

3. RESULTS AND DISCUSSION

The results in table 3.1 indicate that majority of the farmers in the area of interest are females. According to Mbonane (2018), the majority of farmers are females as the male in the family normally migrate for employment in urban areas.

Age is an important factor in better understanding the farmer's perceptions, awareness, and understanding of farming, risks, and solutions. According to Mbonane (2018), older farmers are known to have better farming experience and knowledge whereas younger farmers are known to have a better understanding of innovative solutions. The finding of this study revealed that the majority of farmers in the study area are older than 65 years of age.

Education is also an important factor as it forms part of the characteristics that improve rural household competitiveness through farm income generation and knowledge (Tlholoe, 2015). The level of education may also influence farmers' perceptions, understanding, and awareness of risks and insurance, influencing the demand for insurance thereof as Tafese (2016) indicated that higher education level allows for the adoption of better farming systems and easily absorb new and innovative information. The farmer may further understand farm management and agricultural marketing principles better. The majority of the interviewed farmers did not have tertiary education. as shown in table 3.1.

The results of the study revealed that the average household size is 6 members in the study area. Larger household size is generally linked to higher consumption expenses which may affect their affordability for additional expenses, and this may further impact the demand for insurance and the risk management strategies used. However, a household with a larger household size may also be more motivated to invest in their production through better risk management strategies or demand insurance in order to protect household livelihood since there are more dependents (Tlholoe, 2015).

Income is a fundamental factor that can determine affordability in adopting better and innovative risk management solutions such as crop insurance. Income therefore may influence farmers' demand for crop insurance regardless of whether they see it as an important tool or not but mainly influenced by affordability (Ellis, 2016). Table 3.1 shows that the majority of farmers receive less income to manage their household needs.

TABLE 3.1 DESCRIPTIVE ANALYSIS OF SOCIOECONOMIC CHARACTERISTICS OF SMALLHOLDER MAIZE FARMERS IN LIMPOPO PROVINCE

Description	Measurement	N	Min	Max	Sum	Mean
Gender	(1= Male, 0= Female)	173	0.00	1.00	71.00	0.41
Age	(Years)	173	25.00	71.00	9382.00	54.23
Education	(1=Tertiary,0=lower)	173	0.00	1.00	28.00	0.16
Household size	Number members	173	2.00	11.00	1046.00	6.05
Income	(1=>R126,000pa, 0=otherwise)	173	0.00	1.00	56.00	0.32
Farm size	(1= > 5 ha, 0= ≤ 5 ha)	173	0.00	1.00	14.00	0.08
Farming experience	(1= > 15 years, 0= ≤ 15 years)	173	0.00	1.00	122.00	0.71
Diversification	(1= yes, 0= No)	173	0.00	1.00	131.00	0.76
Better quality seeds	(1= yes, 0= No)	173	0.00	1.00	149.00	0.86
Fertilizers	(1= yes, 0= No)	173	0.00	1.00	148.00	0.86
Irrigation	(1= yes, 0= No)	173	0.00	1.00	127.00	0.73
Savings	(1= yes, 0= No)	173	0.00	1.00	68.00	0.39
Government assistance	(1= yes, 0= No)	173	0.00	1.00	116.00	0.67
Crop insurance awareness	(1= yes, 0= No)	173	0.00	1.00	62.00	0.36
Valid N		173				

Source: authors computation

The majority of the farmers indicated that their farm size is less than 5 hectares. Most of the farmers were farming on schemes that are mostly divided equally among the farmers. According to the FAO (2012), smallholder farmers normally own a small-based plot of land onto which they produce for subsistence purposes and a portion to sell.

More than seventy percent (70.5%) of the farmers who participated in the survey had more than 15 years of farming experience. This may imply that the experienced farmers who are a majority, understand their risks better and may be more confident in their risk management strategies. On the contrary, experienced farmers may also be open to crop insurance based on their loss experience and based on their understanding that production risks have been increasing over the years due to climate change and becoming more difficult to manage (Khan, Chander and Bardhan, 2012).

The majority of the farmers indicated good quality seed as the most used risk management strategy followed by fertilization. Savings was the least used strategy of the five that are mentioned in table 3.1.

It is important to understand the farmers' knowledge or familiarity to crop insurance as it may influence how they demand crop insurance products. Awareness has proven to be one of the main barriers to insurance (Swiss Re, 2017). The observations from table 3.1 are that only 35.8% of the farmers were aware of crop insurance. Most of the farmers understood what insurance was with reference to other types of insurance such as car insurance and life insurance but had no idea that there is also crop insurance that could be used as a risk management

tool to protect crops in case of losses.

4. EMPIRICAL RESULTS

4.1. Factors affecting farmers willingness to join

4.1.1. Farmer's interest in joining index-based crop insurance

After the index products were thoroughly explained to the farmers, they were asked if they would be interested in joining to participate in the index-based crop insurance product without attaching any price or premium rate to the question. The results for willingness to join are summarised in figure 4.1 The graph clearly indicates that the majority of the farmers were willing to join and participate in the insurance product proposed. These results are similar to those of Trang (2013) who found that in three different districts, the majority of farmers were willing to join the insurance scheme as they mainly wanted to protect themselves from unexpected disasters.

4.1.2. Model fitness

In order to analyse the factors influencing the willingness to join, a probit model was applied. Table 4.1 present the results of the probit model ran on different explanatory variables. The statistical results showed that the model was significant at 5% through a chi-square value and the goodness of fit is also measured by the pseudo value of 0.19 which indicate that 19% of the farmers' decision to join in the participation of the index-based crop insurance variation was properly explained by the explanatory variables used. The smallest variable factor is used as the baseline factor by default.

The only variables that showed statistical significance are age at 10%, farm size at 1%, and the two risk management strategies applied, which are crop diversification and government assistance and both significant at 1% and 5% respectively. This means that there is no evidence to reject the null hypothesis which said that the explanatory variables do not influence the willingness to join index-based crop insurance except for age, farm size, and the types of risk management strategies used such as the application of crop diversification and receiving government support. Table 4.1 shows the coefficients of the explanatory variables and their level of significance. The significant variables in this study are different from those of a study by Masara and Dube (2017) with the exception of age. Masara and Dube (2017) found that some of the significant variables were age, income,

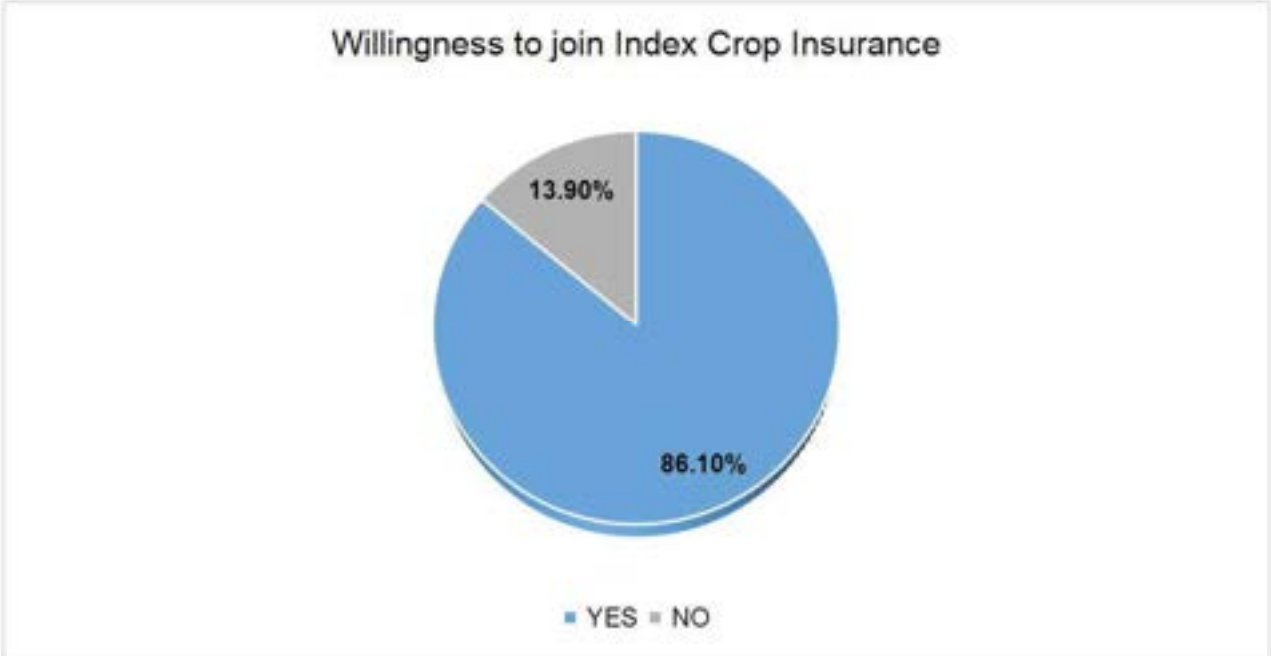

FIGURE 4.1: WILLINGNESS TO JOIN RESPONSES

and years in farming.

Significant factors

Age negatively influences the decision of farmers on their willingness to join in the participation of index insurance or their interest in the product thereof. The negative influence indicates that older farmers are less likely to be willing to join index insurance compared to younger farmers. These results are also in agreement with expected results which was that older farmers may not prefer the use of crop insurance due to their level of insurance understanding according to Tlholoe (2015). However, this influence is contrary to the study done by Masara and Dube (2017) which indicated that older farmers are more likely to take up insurance compared to younger farmers.

The size of the farm positively influences the willingness to join in the participation of index-based crop insurance meaning that farmers with larger farm size are more likely to join in the participation of index crop insurance compared to the farmers with smaller farm size. These results corroborate with the expected results which were that farmers with larger farm sizes may be more willing to join insurance to protect their production as they have more to lose compared to the farmers with smaller farm sizes. Ellis (2016) argued that farmers with larger farm size are more likely to join and pay for insurance as they may have enough income and may need to ensure productivity on their large farms.

Risk management strategies applied

Crop diversity-The variable of crop diversity is at a significant level and negatively influence the decision of farmers to join index insurance, meaning that farmers who apply crop diversification to

TABLE 4.1: PROBIT REGRESSION ON FACTOR AFFECTING THE WILLINGNESS TO JOIN

Dependent Variable	**Willingness to pay**	
Explanatory Variables	**Coef.**	**P>|z|**
_cons	0.655	0.530
Gender	0.156	0.591
Age	-0.027	*0.056
Education	-0.458	0.394
No of household members	0.011	0.862
Income range	-0.471	0.207
Farm size	1.393	***0.005
Farming experience	0.635	0.119
Diversification	-0.898	***0.005
Quality seed	-0.023	0.960
Fertilizers	0.259	0.567
Irrigation	-0.186	0.608
Savings	0.316	0.347
Government assistance	-0.716	**0.015
Crop insurance awareness	-0.022	0.952

Probit regression Obs=173	LR $chi^2(14)$ = 26.10
	Prob > chi^2 = 0.0251
Log likelihood = -56.608381	Pseudo R^2 = 0.1873

****, **, * indicates statistical significance at levels 1, 5, and 10 percent respectively*
Source: Authors computation

their farming are less likely to join index insurance. The results could mean that crop diversification as a strategy may be enough to protect the farmers on its own, hence the farmers do not feel the need for insurance. These results are contrary to the findings by Trang (2013) who mentioned that risk management strategies positively influence the willingness to join, implying that insurance and other risk management strategies may be complementary as risks may not be properly managed without insurance.

Government assistance as a risk management strategy negatively influences the farmers' willingness to join in the participation of index-based crop insurance with a significant influence. The negative influence indicates that farmers who receive assistance from the government to manage their risks are less likely to be willing to join index insurance. The results are what was expected as a negative influence was expected.

5. CONCLUSION AND RECOMMENDATIONS

Crop insurance's use as a risk management tool by the smallholder maize farmers in the Vhembe district is non-existent. Farmers are not exposed to enough information about crop insurance and there is little awareness of this type of insurance. Farmers were interested and willing to purchase the index-based crop insurance product if it was to be provided to them.

The main factor that influenced the WTJ is farm size with a positive influence, and this shows that farmers with larger farm size tend to prioritize their produce as they have invested much. The willingness to join was also strongly influenced by the risk management strategies that the farmers apply, and this is an indication that if the farmers find their risk management strategies to be effective, they will be less willing to participate in insurance. Younger farmers are more open to insurance and are more willing to join. The farmers who were not willing to join the insurance product indicated that they think insurance is expensive while others simply did not trust that insurance is for their benefit which implies that the trust in insurance is also an important aspect on the willingness to join index-based crop insurance.

5.2. Recommendations

Insurance providers should prioritize increasing crop insurance awareness and education for smallholder farmers. Insurance regulators should also consider inclusive insurance policies to accommodate the smallholder farmers in rural areas that have smaller farm sizes and lower income through index-based crop insurance.

Insurers, regulators, and the government should strive to defuse the false perception that farmers have on insurance, believing that insurance is untrustworthy and only expensive. Policymakers need to ensure that there are insurance support policies for smallholder farmers and the insurance regulations should ensure that the farmers are protected as insurance customers and that the index-based crop insurance product is fairly developed to meet the farmers' needs.

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APPENDIX III: PROBIT REGRESSION RESULTS FOR THE FACTORS AFFECTING THE FARMERS' WILLINGNESS TO JOIN IN PARTICIPATION OF INDEX-BASED CROP INSURANCE

Probit regression — Number of obs = 173; LR chi2(14) = 26.10; Prob > chi2 = 0.0251; Log likelihood = -56.608381; Pseudo R2 = 0.1873

indexinsurance_interest	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	.1562286	.2907814	0.54	0.591	-.4136925	.7261498
age	-.027153	.014199	-1.91	0.056	-.0549825	.0006764
education	-.4581393	.5372802	-0.85	0.394	-1.511189	.5949105
household	.0111161	.0638901	0.17	0.862	-.1141061	.1363384
income_range	-.4705354	.3728749	-1.26	0.207	-1.201357	.2602861
farm_size	1.392737	.5005042	2.78	0.005	.4117673	2.373708
experience	.635404	.4075823	1.56	0.119	-.1634425	1.434251
diversification	-.8981189	.3175774	-2.83	0.005	-1.520559	-.2756785
quality_seeds	-.023486	.4714866	-0.05	0.960	-.9475828	.9006108
fertilizers	.2588984	.4518494	0.57	0.567	-.6267102	1.144507
irrigation	-.1862355	.3629749	-0.51	0.608	-.8976532	.5251821
savings	.3162097	.3364598	0.94	0.347	-.3432395	.9756588
government_assist	-.7158237	.2951105	-2.43	0.015	-1.29423	-.1374177
ci_familier	-.0218793	.3630939	-0.06	0.952	-.7335302	.6897716
_cons	.655134	1.043676	0.63	0.530	-1.390433	2.700701